EF2260 Space Environment and Spacecraft Engineering

Comments on Spacecraft design study preliminary reports

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General comments on all reports:

1. There is room for improving the language. Please help each other and read the parts of the report you have not written.

2. Structure. In real life there may be requirements on a specific report structure, here we are not so strict. But there are some fundamentals:

- All equations, figures and tables should be numbered.
- All quantities (symbols) should be explained the first time they are used.
- Quantities (symbols) should be in italics
- Units should not be in italics (groups AB and CD need to correct this)
- Figures should be clearly legible, including the axes (group EF figure 1 is too dark, group EF figures 3-7 has too small text on the axes)
- If you borrow figures, please give a reference in the caption (group CD figure 2 – did you make it yourselves?)
- All abbreviations should be spelled out the first time they are used. If there are many abbreviations is a good idea to include a separate, complete list of abbreviations.

3. Contents: The reader should be able to follow all calculations. There are many examples of numbers which pop up in the text without explanation for where they come from or how they were calculated, e.g. numbers for power and mass.

4. Specific question to all groups: Please make it more clear about the coordinate system XYZ for the thermal analysis, and why/why not you have placed equipment on only some of the 6 faces. Which face is in the velocity direction, which face is downward towards the Martian surface, which face is sunward, which face is earthward, and is all this consistent?

5. Include at the end a summary of solar panel power and area, battery capacity and mass, and figure of merit (data volume per launch mass).

Some specific comments to each group (you may benefit from looking at the comments not only to your own group):

Group AB
Section 3.2.2, the total data size is given ad 5.33-15.98 MB. This is presumably per orbit. You need to complete the calculation of the figure of merit for the entire mission (MB/kg).
Section 3.3.2 mentions power of 50 W in eclipse. Please include a table of all power consumers, for sunlight and eclipse.

Table 7, what is meant by last line “Power dissipation 4.48 W”?
Last line before section 4, explain how 185 kg was computed.
Conclusions: Table 17 should come earlier in the report. Please summarize here the solar panel power (W) and area (m2), and battery capacity (Ah) and mass (kg), and also the figure of merit (MB/kg).
In presentation, slide 9, you write mb, Kb/Kg, mb/s, kb/s, Kg. Please use m=milli, M=mega, k=kilo, b=bit, B=byte.

Group CD
End of page 4: A figure would help the reader understand the discussion. I did not understand why the Mars-Sun direction is not chosen to be perpendicular to the orbit plane.
Section 4.3.2, how is payload mass 195 kg computed?
Section 5.2, equation (15), how is the energy 397.5 Wh computed?
Section 5.2, after Table 4: I cannot follow the calculations leading to 55 kg and 20 l.
Section 5.3, how is the required power of 2 kW computed?
Figure 3(b), the 3 arrows are confusing. Leave just the bold arror and change the other 2 arrows to just lines without arrowheads.
With the selected orbit you exclude a 200 km area around the poles. Maybe this is the most interesting area in search of water? Just a comment…

Group EF
Figure 2: Why does the curve show 50 min eclipse for 0 km altitude?
Table IV: What is meant by the solar panels consuming 1700 W?
Mapping of surface: I would think that the spacecraft maps the surface throughout the 3-year mission, to observe variations, etc, so the total data volume will be much larger than if the surface is mapped only twice. You will then get a significantly larger figure of merit at the end (MB/kg).

General comments by Nils Pokrupa at OHB (freely interpreted by PAL):

1. A torque budget might be useful. For the reaction wheels, it is advisable to avoid zero crossings (i.e. the wheels are not spinning at all).

2. Table of requirements is very good. Group CD had a simple table in the presentation, in reality there are several levels: mission, science, system, subsystem, instrument req’ts, etc. In a large project there can be 10000’s of requirements, and it is necessary to keep track of them all. Use dedicated software for this.

3. Good to include a mode diagram to keep track of possible spacecraft operating modes.

4. Comments on hot solar panels, solutions may be mirrors between the cells, and/or tilting of the panels.

5. Thermal analysis is difficult, iterative process, you have done it well.

6. The reports must include tables of mass and power. These are essential.

7. Oral presentations good, written reports need to be improved. References to web pages should include date accessed.

8. The System Engineering process: an interactive process tying together all the subsystems, difficult but essential to the mission success.

9. During reviews, only some people are presenting. All others should be attentive, taking notes of upcoming issues and questions (the presenters will not do this) for later discussion in the groups.

10. How to communicate within a project: Do NOT use e-mail, you will lose track. Use dedicated project management software, there are many different ones available.